1. The gravitational field strength on the surface of a planet with twice Earth's mass and the same radius is:
   a) 4.9 N/kg
   b) 9.8 N/kg
   c) 19.6 N/kg
   d) 39.2 N/kg

2. The magnitude of the electric field at a point 0.5 m from a +2.0 μC charge is:
   a) 7.2 × 103 N/C
   b) 3.6 × 103 N/C
   c) 4.0 × 104 N/C
   d) 8.0 × 104 N/C

3. A proton moving at 2.0 × 106 m/s enters a magnetic field of 1.5 T at right angles to its velocity. What is the magnitude of the magnetic force on the proton?
   a) $2.4 \times 10^{-13}$ N
   b) $4.8 \times 10^{-13}$ N
   c) $6.0 \times 10^{-13}$ N
   d) $1.2 \times 10^{-13}$ N

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4. Two masses, 5.0 kg, are separated by a distance of 2.0 m.
   a) Calculate the gravitational force between them.
   b) What happens to the force if the distance is halved?

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5. A +1.5 μC charge is placed 0.2 m away from a +2.0 μC charge.
   a) Calculate the electric potential energy of the system.
   b) Is the potential energy positive or negative? Explain.

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6. A +3.0 μC charge creates an electric field.
   a) Calculate the electric field strength at a distance of 1.0 m.
   b) If a +2.0 μC test charge is placed at this point, find the force it experiences.

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7. An electron moving at 5.0 × 106 m/s enters a 0.010 T magnetic field at right angles to its motion.
   a) Calculate the magnetic force on the electron.
   b) Determine the radius of the circular path it follows.
   (Mass of electron = $9.11 \times 10^{-31}$ kg, charge of electron = $1.60 \times 10^{-19}$ C)

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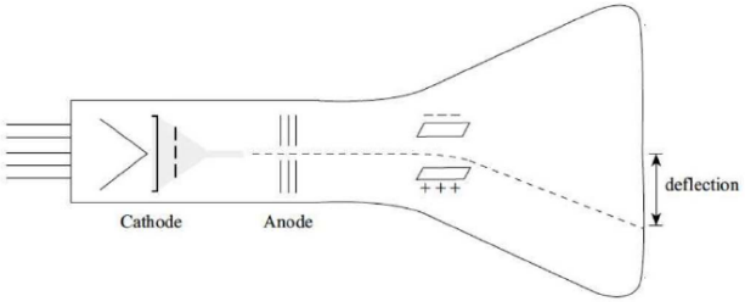
8. Compare and contrast gravitational and electric forces in terms of:
   a) Dependence on mass vs. charge
   b) Nature of the forces (attractive or repulsive)

9. A charged particle enters a magnetic field at an angle of 90° to the field lines. Explain:
   a) Why the particle experiences a force.
   b) Why the force does no work on the particle.

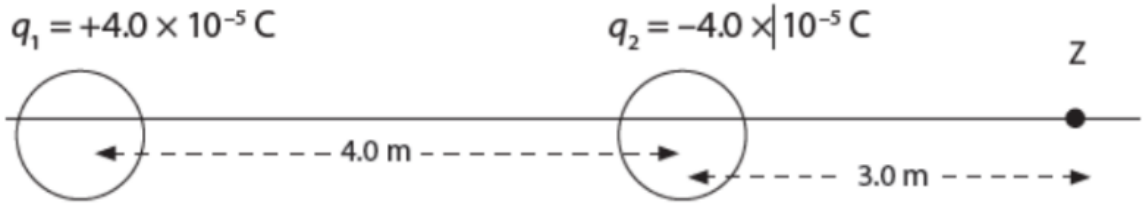
10. Explain why astronauts in orbit feel weightless even though Earth's gravitational field still acts on them.

11. In a cathode-ray tube, electrons are accelerated from the cathode towards the anode by an accelerating voltage $V_a$. After passing through the anode, the electrons are deflected by the two oppositely-charged parallel plates.




If the accelerating voltage Va is decreased, will the deflection increase, decrease, or remain the same? Using principles of physics, explain your answer. [K – 4 marks]

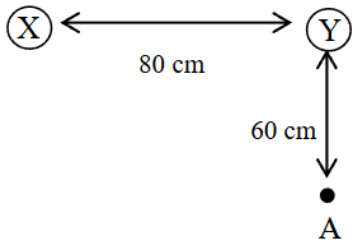
12. Examine the charge distribution shown.



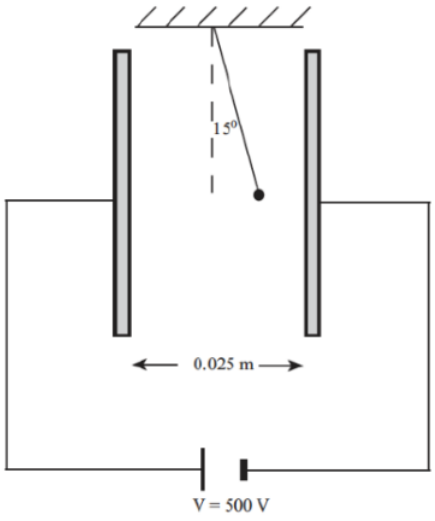

a) What will the net force be on a third charge of $qq_3 = -3.0 \times 10^{-5}$ C placed at point Z? **(4 marks)**

**13. Fields**

Determine the electric field strength (magnitude and direction) experienced by a test particle at the point A, due to the two charges X ($-2.5\times10^{-5}$ C) and Y ($+3.9\times10^{-4}$ C).




14. A small $4.0 \times 10^{-3}$ kg charged sphere is suspended by a light thread between parallel plates, as shown in the diagram below. When the plates are connected to a 500 V source, the thread makes a 15° angle with the vertical.




If the charge on the sphere is doubled, what is the angle the string will make? Include a Free Body Diagram. [A – 5 marks, T – 5 marks]